# Chapter 15

# Wounds and Injuries

*"I have learned that I should be careful with the words I choose to say when I am angry because later, those words always leave a huge wound of regrets in my heart besides hurting the loved ones. Those wounds can't be healed!"* --- Nino Varsimashvili

## 1. Concept

For a medical person, injury is simply some kind of damage to any bodily tissue or organ; but for a lawyer, its definition is much wider as it denotes any harm caused unlawfully or illegally to a person's body, mind, reputation, and property. Legally speaking, mental torture to somebody is also an injury that deserves higher punishment and compensation. Medically speaking, wounds and injuries are concerned with physio-pathological aspects of human body that denote any physical injuries to dermis, tissues, human organs and to the free mental function.

Forensically speaking, wounds and injuries may be caused by: (a) self-infliction (fabricated wounds), (b) accident or (c) other's malicious or negligent activities. Injuries have numerous classes and types depending upon the nature of weapon that caused it, manner of infliction and so on.

## 2. Types

Medically, wounds and injuries can be classified[75]

## 1) Mechanical injuries

### A) Due to blunt force

#### a) Abrasion

Abrasion is the damage or destruction of superficial epidermis of the skin. It heals without formation of permanent scar. Thus, it is minor in nature and does not cause serious harm to the victim. Hard, blunt or rough force applied on body surface causes abrasions. It has following categories:[76]

1) Scratches or linear abrasion: It is caused due to horizontal or tangential friction of edge of chair, needle or tip of pointed weapon etc. It is noticed wider at starting point than at exit. Minute examination of this helps to trace- the type of weapon, direction of application of force, the relative position of victim and the assailant.
2) Grazes or sliding abrasion: It may be produced due to horizontal or tangential friction of body parts with rough surface of ground or weapon or object. It is seen more commonly in hit and run cases. Its starting point is wider and deeper and is narrower and thinner at exit point.
3) Pressure abrasion: This is result of more or less perpendicular application of force on the body surface and is directed towards the inward depth of the body. Example- abrasion on the ligature marks around the neck in case of hanging or strangulation. Nail abrasion is present on the neck in case of

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[75] Dr. K.S. Narayan Reddy, The Essentials of Forensic Science and Toxicology 148 (21st ed. 2002).as follows:

[76] Supra note 1 at 149

throttling. Sign of teeth in case of teeth bite is also common.

4) Imprint or pattern abrasion: Impression of weapon used in offence can be estimated through imprint abrasion. Example- cycle chain, automobile grill, or tyre of wheel etc. If rod or stick is used as weapon, two parallel lines of abrasion appear with a gap in between two lines roughly equal to breadth of stick.

5) Nail scratch or abrasion: It is caused by horizontal friction or by pressure of nails to epidermis.

[Abrasion: *See figure 15.1 in figure section]*

## Medico Legal Importance of Abrasion

Study of abrasion has following importance:

- Abrasion though simple by themselves may be dangerous to vital organs deeper to the site of the abraded area.
- Mostly abrasions are caused accidently, then after homicidal and the least commonly suicidal.
- Abrasions may be self-inflicted to bring a false charge of assault against some person.
- From abrasion, the type of weapon used could be identified. (E.g. imprint abrasion)
- Direction of application of force and relative position of the victims and assault can be known from linear or graze abrasion.
- Abrasion over the cornea may amount grievous hurt causing permanent corneal opacity.
- Abrasion indicates the type of offence committed. If abrasion is near private parts or breast of women, it indicates sexual offence. If nail scratches are seen in neck, it indicates attempt of throttling or manual strangulation. Abrasion around the nose or mouth of deceased indicates killing by smothering.

- They may be the only external signs of a serious internal injury.
- Abrasions on face or body of assailant indicate struggle between victim and offender.
- The time of assault or injury can roughly be ascertained from color changes in abrasion.

Red: when fresh

Reddish: 8 to 24 hours later

Brownish: 2 to 3 days

Dark brown: 2 to 5 days

Blackish: 6th day and scars start falling off from the margins.

## Differences between Ante Mortem and Post Mortem Abrasions

It is very difficult to differentiate between abrasions produced slightly before death and after death even by microscopic examination. After death, abrasions may be produced if the dead body is dragged from the crime scene for number of purposes such as to hide dead body or conceal homicide. Some differences are:

| Differences | Ante mortem abrasions | Post mortem abrasions |
|---|---|---|
| *Scar formation* | Present | Absent |
| *Wound color changes* | Present | Absent (mostly yellowish without change) |
| *Parchmentisation* | Absent | Presence of parchmentisation of skin at the ligature site. |
| *Site* | Anywhere on the body | Usually over bonny prominences |
| *Microscopic examination* | Intravital (in cell) reaction & | Absent |

| | | |
|---|---|---|
| | congestion seen | |

## b) Bruises (Contusions)

An application of hard blunt force into the epidermis could result effusion of blood into the tissue due to rupture of blood vessels or capillaries. This effusion formed in the skin or subcutaneous tissues is known as bruises (general term) or contusion (medical term). An act of striking the body part through blunt weapon such as stone, stick, heavy metal, fist etc. ruptures the capillaries or blood vessels of the affected areas and cause ecchymosis (oozing of blood from a ruptured blood vessel into the tissues). The contusions could also be formed in internal body organs such as heart, lungs, brain, muscles and any other inner tissues. However, contusion usually forms at skin or at subcutaneous tissues.[77]

[Bruise (Contusion) : *See figure 15.2 in figure section*]

Contusion has some following special features:[78]

- Shape of contusions is usually roundish to take the shape of the striking part of weapon.
- A fresh contusion is reddish. Its colour changes with time and subsides by two weeks.
- With rupture of capillaries, there is also damage in the soft tissue. However, skin is usually spared because skin tissue is quite tough.
- The margin of bruise is not sharp due to diffusion of the blood in surrounding tissue.
- If the blunt force has affected large blood vessel then a

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[77] Supra note 1 at 151

[78] Apurba Nandy, Principles of Forensic Science 212 (2nd ed. 2003).

tumor-like mass called haematoma may form.

- When surface of weapon is patterned that may be imprinted on contusion, referring as patterned contusion.
- A fresh bruise is usually tender and slightly raised above the surface of the skin, and even a deep-seated bruise shows some swelling when compared with the opposite limb or part of the body.
- Formation of contusions differs in size from pinhead to large collection of blood in the tissues. Generally, its size is larger than the surface of weapon applied in the body.

## Factors Affecting Formation of Contusions

Factors playing role in formation and appearance of contusions are as follows:

1) Quantity of the force used: A greater force is more likely to cause a bruise. With still greater force, hematoma may be produced. An ecchymosis is a hematoma of the skin larger than 10 mm.

2) Quantity of force: Striking with weapon such as stone, stick, fist or shoe will produce a bruise but striking with a bag of sand or covering the part of the body with a rug before hitting with a stick may not produce a visible bruise.

3) Site of application of force: Some body parts such as back of trunk, anterior wall of the abdomen are more capable to absorb force and are able to resist formation of contusions.

4) Sex: Contusions are easily formed and seen even with minor forces in female body due to delicacy of subcutaneous fatty tissues than the vessels present in the tough fibro-muscular tissue in male.

5) Age: Bruises are easily formed in infants, young children and very old persons due to looseness of tissue than in young

adults.

6) Certain pathological conditions: Person suffering from scurvy, purpura, leukemia, vitamin-K deficiency, hemophilia, phosphorus toxicity etc. develop bruise easily without application of much force.

7) Complexion of person: Fair complexion in a person's body makes bruise clear in visibility than in black skinned person.

8) Shifting of bruise or appearance of a bruise at a site away from the site of impact: When blunt force is applied at a site having tough tissue or at a place having no area for deposition of blood, the extravagated blood seeks loose tissue area and settles down there. In this case, contusion is formed at different part than the place where force was actually applied. For example, if force is applied in forehead, contusion may form in eyelids.

## Medico Legal Importance of Bruise

Medical examination of contusion is helpful to extract following information:

1. Generally, bruises are considered as simple injury but multiple extensive bruises distributed all around the body can be fatal and be considered grievous.
2. Bruises are produced by hard blunt impact that may cause serious injury to the immediate internal vital organs and result in death.
3. Generally, bruises are accidental or homicidal in nature. A suicider does not want painful injuries during death, thus formation of bruise in suicidal case is rare.
4. A person aiming false claim against other may create abrasions rather than contusions due to extreme pain in creating contusion.

5. False bruise or bruise like lesion may be produced by application of some chemical or plant juice (e.g. Semicarpus anacardium) to bring false charge of assault against somebody.

6. Changes in bruise colour helps to estimate time of assault. Colour change is noticed due to chemical changes in red blood cells. The pattern of changes of colour are as follows:[79]

   - Fresh bruise is red.
   - After few hours, it turns blue and remains blue upto 3 days.
   - Bluish black by 3rd to 4th day, due to haemosiderin pigments.
   - Slight greenish by 5th to 6th day due to presence of haematoidin pigments,
   - Yellowish by 7th to 12th day due to presence of bilirubin pigments
   - Then fades away and clears up.

7. Patterned bruises depict the information about weapon used.

8. Shifting of the extravasated blood and appearance of bruise at a different site may create confusion about the application of force.

9. It takes some time for deep extravasations to become visible hence, if examined early; they may escape detection.

10. Bruise helps to indicate nature of offence committed such as- hurt, sexual offence, attempt to murder.

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[79] Government of Nepal, Ministry of Health and Population, Population Department, Clinical Protocol Relating to Gender Violence, 115.

11. In pathological conditions like blood dyscrasias, bruises like lesions may be produced with application of slight force or no force at all.
12. Formation of bruise is an ante mortem phenomenon. Post mortem bruises are very rare and do not show any change in colour, except which occurs due to decomposition.

## Real Bruise versus Fabricated Bruise

A person having faulty motive may create fabricated bruise in his own body to make false charge or to avoid punishment or to cause harshness to other. Fabricated bruises are generally caused through application of chemical or other substances. A clear medical examination of such fabricated bruise reveals its original character. Some differences between original bruise and fabricated bruise are:

| Differences | Original bruise | Fabricated bruise |
|---|---|---|
| Margin | Diffused (irregular) | Regular/clear |
| Swelling | Slight | No swelling |
| Abrasion over bruise | May be present | Absent |
| Changes in colour | Changes with the age of bruise (red-blue-brown-green-yellow) | No change in colour |
| Extravasations of blood | Present in subcutaneous tissue | Not present |
| Chemical test of skin or scrapping | Detects nothing | Detects chemical or plant juice used |
| Effect on subcutaneous tissues | Usually present | Absent |
| Shape | Usually larger than the surface of impacted weapon | Not defined, based on chemical applied |

## Post Mortem Lividity versus Contusion

The primary difference between post mortem lividity and contusion is in its formation. The former is formed after death of person, meaning that the life of person is irrecoverably lost whereas later is formed due to rupture of blood vessel and creation of effusion into skin or subcutaneous tissues. Presence of post mortem lividity is a clear sign of death of person. However, in contusion, life of person is not affected. General differences between post mortem lividity and contusion are:

| Differences | Post mortem lividity | Contusion |
|---|---|---|
| Medico legal importance | Clear sign of death | Clear sign of violence and blunt force |
| Volume of blood that forms stain | Entire blood of body | Limited blood effused due to impact of force |
| Recovery | No recovery by body. Leads to decomposition | Living body itself heals/recovers contusion. Fades out with time |
| Formation place | On lower part of dead body. Due to gravity | Skin or subcutaneous tissues where force applied. Rarely, on lower loose tissues if force applied at tough tissues. |
| Margin | Sharp and clearly defined | Diffused margin, irregular |
| Nature of changes | Post mortem | Ante mortem |
| Colour | Reddish purple normally. However in poisoning, depends on nature of poison | Fresh contusion is reddish and start changing with passage of time |

If the dead body is stroked or concussed slight after death, contusion may form. Often, medico legal practitioner may require to differentiate ante mortem and post mortem contusion. Ante mortem and post mortem contusion carry some specific differential features such as swelling, damage to epithelium, extravasation, coagulation and infiltration of tissues with blood and colour changes are prominent features in ante mortem contusion. Whereas, these prominent features are absent in post mortem contusion.[80]

Any contusion either post mortem or ante mortem, will gradually disappear after advancement in the process of post mortem lividity in dead body. At the autopsy table, sometimes bruises may be difficult to demonstrate or may be obscured by patches of postmortem lividity or by the dark color of the skin. Scalp contusions are demonstrated by reflecting the scalp after making an incision. Bruising of the neck are demonstrated by reflecting the skin and exposing the underlying structures and the inner aspect of the skin. In the subcutaneous tissues wherever confusion arises, bruise can be demonstrated by giving parallel incision through the skin. Deep bruises are demonstrated by giving deep incisions into the muscle. Examination of whole body under UV light makes the bruise visible,[81]

### c) Lacerations

Laceration wound is tearing of the skin, mucosa and underlying tissues. Laceration is the result of application of blunt force in the body surface where the effect of blunt force crushes or stretches the affected tissues beyond their natural limits of elasticity. Body tissues are separated and sometimes even displaced from its firm. It has irregular margin and the hemorrhage is less in comparison with the size and extent of the wound because of early clotting of blood at the site due to gross damage of tissue. As per mode of production, laceration could be classified as follows:[82]

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[80] Supra note 1 at 154

[81] http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000701/M015742/ET/1464332025FSC_P14_M17_e-text.pdfwhich can be missed by naked eyes.

[Lacerations : *See figure 15.3 in figure section]*

1) Split laceration: Split laceration results due to crushing of skin or subcutaneous tissues between two hard objects, one being the underlying bone. If a linear weapon such as a stick causes split laceration, then it looks like incised wound.

2) Stretch laceration: Stretch laceration is produced when heavy forceful frictional impact causes overstretching of the skin and subcutaneous tissues along with flapping of skin. The piece of skin flaps opposite to the direction of force used.

3) Avulsion: When a heavy object produces grinding compression over body part, the underlying tissues may separate from skin known as avulsion. Gross damage on muscles, soft tissues are experienced under it. This may be caused when motor vehicle such as lorry passes over the body or through pressure crated by heavy machine.

4) Tears: Tears result from irregular tearing of the skin and tissues. Frictional stretch by the irregular or pointed end of a weapon or an object on the surface of body produces tears. For example contact of body surface in motorcar, door handles, or blows from broken bottles.

5) Internal laceration: Internal laceration may occur when blunt force exceeds the tensile strength and elasticity of an internal organ or tissue. Laceration may result in such organ without any surface tear and bruises or abrasion at the impact site. Laceration on internal organs may be caused by:

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[82] Supra note 1 at 218.406

- Direct injury of the viscera by fragments or fracture bones,
- Development of traction shears or stain shears in the viscera,
- Stretching of the visceral attachments,
- Hydrostatic forces

## Features of Lacerated wound

A lacerated wound points following features:

1) Margins are irregular.
2) Contusion may be seen in skin or subcutaneous tissues around the wound.
3) Deeper tissues may be crushed or stretched.
4) Hair of the affected area are crushed.
5) Foreign matter such as hair, mud particles, lead particles etc. may be found.
6) The shape and size may differ from the shape and size of the weapon used.

## Medico Legal Importance

The medico legal importance of laceration and its examination are:

1) Massive internal injuries may be present even if evidences of injuries are absent externally. For e.g. a kick or punch on the upper abdomen may affect the duodenum or pancreas, and causes death within a few days from peritonitis.
2) Tissues are crushed and hemorrhage is less and may give rise to infection if victim survives.
3) Inspection of depth of lacerated wound may reveal foreign material or trace evidence such as piece of paint, grease, grit etc. indicating the agent or surface responsible for injuries.

4) Inspection of scene of crime may show some evidences of contact with the tissue. For e.g. blood, hair, and tissues fragmented.

5) Commonly lacerations are accidental and their severity differs as per the circumstances of case. Suicidal lacerations being much painful are rare. However, concussion during jump from cliff, running bus, running train etc. is common.

6) Lacerations leave permanent scar, which may link the person with an old injury inflicted long time back.

7) Post mortem lacerations (gross) may be caused by placing the dead body in front of a running vehicle or a train to conceal the anti mortem homicidal injuries.

8) Time of infliction of lacerated wound could not be satisfactorily estimated because lacerations do not have uniform healing timing and process.

9) Bedsores might sometimes be confused with laceration. Therefore, the circumstances should be considered.

10) Extensive use of blunt force injury over the body may amount grievous hurt and even attempt to murder in accordance to the site of force applied.

## Combination of Abrasions, Contusions and Lacerations

Sometimes it is hard to differentiate types of wound as abrasions, contusions and laceration because all three classes of injuries may be found in the same wound and the same weapon or object could cause these injuries. If imprinted weapon is used to produce blow, it may be difficult to determine whether that was abrasion or patterned contusion. Single blow of a punch could result abrasion and contusion. If punch is made in loose or smooth tissues such as eyelids, lips, nose, jaw, internal or external laceration may be seen.

### d) Fractures and dislocations

A bone fracture is a medical condition in which there is damage in the continuity of the bone. Fracture of skull, cervical vertebrae, dislocation of joints or bones etc are more common among driver, passengers, and pedestrians during road traffic accidents/injuries. Fracture could be even due to the secondary cause of electric injury.

## B) Due to sharp edged weapons

### a) Incised wounds

An incised wound is an injury caused by a weapon with a sharp cutting edge when it is drawn across the skin. Such weapons include knives, jagged portions of metal or pieces of broken glass, sickles etc. The injury is produced in the form of cut or slashes. Length of incised wound is greater than depth and margins are clean cut. Blood vessels are cut crossed and not torn. Therefore, bleeding is profuse (excess). Blood escapes freely and is not confined like in bruise. Sometimes, the underlying bones may show superficial cut. Excessive hemorrhage from incised wound may result death due to leukemia and other medical conditions. In a case,[83] the victim died due to cut of wrist through knife. Based on motive behind producing incised wounds, it could be classified into following types:

[Incised wound : *See figure 15.4 in figure section]*

1) Homicidal incision: Weapons used to cut or slash body parts or tissues are considered as lethal weapon. Use of lethal weapons to commit crime is a factor that aggravates degree of punishment after conviction by court. A minor cut

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[83] Bharat B.K. v. Nepal Government, 2071, D.N. 9230

over the sensitive body part may be dangerous and could take life of the victim. In some jurisdictions, use of lethal weapon alone could be treated as intentional despite provocation.[84]

Weapons like sickle, *katari, khukuri,* axe, knife etc. are considered as lethal weapon. Sometimes, attempt to murder versus grievous hurt is to be distinguished and in such situation, it would be helpful to consider factors like- site of the blow, effect of the injury, intention of the offender etc.

2) Accidental incision: Accidental incised wound may be produced in case of negligent handling of weapon or careless use of weapon. If a child meets sharp edge weapon, the child may accidentally cut own hand or other body parts. Falling upon sharp weapon is common method to accidental incision.

3) Suicidal incision: The act of cutting veins in wrist, cutting throat by blade or knife etc. is a common form to give up life. Massive blood hemorrhage is primary cause of death in such case. Suicidal incision is uniform in depth and direction. Hesitation marks are noticed in suicidal incision.

4) Defense incision: When a victim reacts against attack of assailant, defensive incisions are produced. Generally, defensive incisions are seen at palm and front of hands.

5) Fabricated incision: Fabricated incision is produced by victim oneself or with conspiracy to other with motive of subsist false charge against other or to avoid legal sanction against himself. The depths of incision are less in fabricated incision. Accordingly, fabricated incision is not produced in sensitive body parts such as near side of heart, throat, face etc. Multiple superficial cut over non vital and easily visible

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[84] No. 13 & 14 of the Chapter on Homicide in the then *Muluki Ain*, 2020.

body parts are the unique characteristics of fabricated incised wounds.

## Medico Legal Importance of Incised Wounds

- The shape and size of incised wound indicate nature of weapon producing injuries.
- The sight of incision determines gravity of offence and degree of culpability.
- The depth of incision provides idea of direction of force used and relative position of assailant and victim. The beginning point of the cut is wider and deeper than the end of the incised wound.
- Width of wound is greater than width of the blade of weapon causing it.
- Position and mode of production of wounds may indicate character such as whether suicidal, accidental or homicidal. Incised wounds on palm indicate defense injuries. Multiple superficial incised wounds on accessible parts of body indicate fabricated injuries.
- Incised wounds with hesitation cuts indicate suicidal attempt. Homicidal incised wounds are without hesitation cuts and are usually associated with defense injuries.
- In case of throat incision, the cause of death is either from massive hemorrhage due to cut carotid artery or from air embolism due to the partial ventilation of jugular vein.

## Differences between Homicidal and Suicidal Throat Incision

There are some basic differences[85] in homicidal cut and suicidal cut of throat. They are as follows:

| Differences | Suicidal wounds | Homicidal Wounds |
|---|---|---|
| Site of cut | Mostly cut in left side. (Except suicider is left handed person) | Mostly, front side. |
| Edge of cut | Multiple superficial cut overlap the edge | A clear cut, sharp is seen. |
| Direction | Above downwards. Left to right in right handed persons. | Transverse or from below upwards. If attacked from right side of victim, wound runs from left to right, if from behind, it may resemble suicidal wound. |
| Multiple wounds | Number of superficial wounds are noticed | Single, deeper wound is seen |
| Position of cut | Usually above the larynx | Below the larynx |
| Sign of hesitance | Present | Absence |
| Tailing | Present | Absent |
| Depth of cut | Multiple wounds with less severe depth | Single cut of more depth |
| Cut weapon at crime scene | Usually present | Usually absent |
| Defense wounds | Not present | May be present due to struggle |
| Condition of clothes | Normal. No violence marks | May be torn or cut by weapon |
| Blood stain in front side or chest | Usually present as suicide cuts own throat by standing or sitting on chair | Bleeding is from either side of neck and deposit to side. |

## b) Chop wounds

Chop wound is a form of injury caused by sharp edged weapon. Injury is produced by blow of more serious and heavy weapons such as axe, saber etc.[86] A body tissue or organ may completely be chopped away from the body. Chop wounds are more dipper and broader than incised wound. Chop wound commonly produces an incised wound associated with cut into the underlying bone. Dull chop weapons, such as a shovel, produces more crush injury than sharp force injury.

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[85] Supra note 1 at 160

[Chop wound : *See figure 15.5 in figure section]*

### Medico-legal Importance of Chop Wound

- Chop wounds are generally homicidal wounds.
- Usually inflicted on exposed body part such as chest, head, torso, shoulder, neck, scalp.
- The edges of cut are clear and deep.
- Weapon used in chop wound could be predicted through examination of injury.
- The healing process of chop wound is slow and steady.

## C) Pointed sharp-edged weapons

### a) Stab Wounds

A stab wound is an injury caused by a more or less pointed weapon when it is driven into a body through the skin. Its depth is greater than length and width. It is usually caused by a knife, needle, an arrow, scissor etc. In a case,[87] the defendant stabbed victim with a local weapon *khukuri.* Stab wound includes the following features:

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[86] Nagesh Kumar G Rao, Textbook of Forensic Medicine and Toxicology, 32 (2nd ed. 2010).

[87] *Chitra Bahadur Danuwar v. Government of Nepal, 2071* D.N. 9191

[**Stab wound (multiple with double edged sharp weapon)** : *See figure 15.6 in figure section]*

- Entry wound is bigger than exit wound.
- Number of wound is equal to the number of stabs.
- Size (width) of wound can exceed size (width) of a weapon used due to scrimmage (enlargement), but can never be smaller than the weapon when stabbed completely. Scrimmage enlargement is an extension of wound due to motion of the weapon or body against the cutting edge. Pointed instrument may enter the peritoneal cavity through the vagina during attempt of abortion and may cause death. Thus, it should carefully be looked at especially in case of infanticide, where no other cause of death is obvious. Death may result in an infant even if a pin or needle is pushed into the brain or to the eye or through the nape of neck.
- The direction of stab wound could be ascertained or traced by drawing an imaginary line joining entry wound and exit wound. It helps to determine relative position of victim and assailant as well.
- It is desirable to conduct x-ray of stab wounds in search for a possible broken part of weapon or other foreign objects inside victim's body.
- At autopsy, when stab wound is seen to go through cartilage or bone, the cut surface must be saved in formalin for possible tool marks comparison with suspected weapon.
- It is generally not possible to measure the depth accurately due to the presence of blood clots or injury to internal viscera.
- Exit wound is usually present.

## Entry wound

Entry wound denotes wound caused by puncture using a weapon. Usually, the entry wound is larger than exit wound. Objects such as knife, dragger, scissor, needle, injection or pointed wooden objects etc. can be used as weapon causing stab injury. Its depth is greater. However, when the object is twisted, half drawn and again inserted in other direction the depth and direction of the injury changes. The direction of wound is determined through post mortem examination. The edges of entry wounds are inverted. Usually there are three shaped weapons that cause stab wounds: (a) Single edged weapon: Wedge shaped injury e.g. knife. (b) Double edged weapon: Causes elliptical shape of injury e.g. sword. (c) Round shaped weapon: injury by projectile

## Exit wound

If the weapon or object comes out from other part of body, it makes transfixing wound, also called perforating wound or exit wound. The edges of the exit wound are everted.

## Medico Legal Importance of Stab Wound

By examining or observing stab injury and its nature, one can explain whether the stab injury is accidental, suicidal or homicidal. An accidental stab injury may result if a person falls on pointed weapon such as knife, dagger, nail, needle, spear, arrow, screw driver etc. Suicidal stab wound is superficial in nature and inflicted on the approachable body parts. Main deep puncture wound is surrounded by number of minor punctures. Homicidal stab wounds are deeper and multiple. Homicidal stabs are mainly made on serious body parts such as abdomen, heart, chest etc. Remarkable number of defense wounds could be noticed in homicidal stab.

- Direction of stab indicates the relative position of victim and assailant.
- Amount of force applied is ascertained through the depth of

injury produced.

## D. Firearm Injuries (punctured wounds)

Wounds and injuries caused by projectile of firearm are known as firearm injuries. A gunshot produces immense velocity thus, bullets are powerful to cause more dangerous injuries than its size. Firearm may also cause other forms of injuries such as abrasions, contusions, laceration. However, firearm injury is more prominent and easily differentiated from other types of injury. Firearms are usually opened against a person with intention to take life. Thus, bullet is targeted to hit the person and made to enter into body causing more serious damage to body tissue. Massive blood hemorrhage from the injury, and severe damages on viscera are more usual to cause death in firearm injury. In a case,[88] autopsy report revealed that deceased died of massive injuries to the heart and lungs producing severe internal hemorrhage leading to shock and death caused by fire arm injury. Two bullets were projected against the deceased in the case.

## Types of Firearm Injuries

Detail discussion regarding ballistics and explosives has already been made in Chapter 7. On the basis of distance between muzzle and victim, rifled firearm wounds may be classified into following types:[89]

1) Contact wound: Contact injury results when muzzle is connected with body surface of the victim at the time of gunshot. If the muzzle of the gun contacts skin with bone such as on head, the bullet at first enters into the skull through scalp. Due to resistance effect of skull, some parts of gases and parts of bullet may reverse backward causing

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[88] *Government of Nepal v. Sanjeev Kumar Singh Yadav 2064,* D.N. 7888

[89] R.K. Sharma, Concise Textbook of Forensic Medicine and Toxicology, 84-85 (3rd ed. 2011).

eversion of margin. In this case, entry wound may be seen as cruciate or star shaped. Accordingly, if the contact is with skin having no bone underneath, the bullet completely enters into body without any resistance. Some features of contact injury are as follows:

- The chemical reaction between carbon monoxide and hemoglobin produce pinkish colour in hole caused by the bullet.
- Laceration of muscles, vessels and nerves are seen around the entry wound.
- Bullet may enter into body cavity or may expel from exit wound.

[Contact wound (Gunshot) : *See figure 15.7 in figure section]*

This is a contact gunshot entrance wound. Since the barrel contracts the skin, the gases released by the fired round go into the subcutaneous tissue and cause the star-shaped laceration. Note also the grey-black dislocation from the soot, as well as the faint abrasion ring.

2) Close range wound (20 cm non contact range): In close range, the muzzle of the gun is not in contact with body surface but too close to produce remarkable burning effect of gunpowder particles. Shoot particles are seen around the injury. Abrasions and contusions may be seen.

3) Medium range wound (20 cm up to 100 cm range): In medium range, wounds burning and tattooing are not usually seen. Clear observance of entry wound is possible. The entry wound is usually oval in shape, inverted margin and smaller than the exit wound caused by bullet. Surrounding part of the wound may sustain abrasion collar. Abrasion collar is also known as abrasion ring or abrasion rim. It is a narrow ring stretched, abraded skin immediately

CS CamScanner

surrounding projectile wounds, such as gunshot wound.

4) Distant or out of range wound (out of tattooing range): The body is away from the appropriate range of the firearm. Therefore, there is maximum possibility of missing the target. Bullet may not enter into body but may be passed through touching skin or body tissue and may produce abrasions or contusion at affected body parts.

## Entry Wound versus Exit Wound

Every firearm injury has entry wound but presence of exit wound depends on other circumstances such as velocity of gunshot, affected area, distance between shooter and the victim, body capacity to resist etc. If the bullet is capable to pass impacted body completely, exit wound will be seen. There are following differences between these two wounds produced by the same gunshot and same bullet:

| Differences | Entry wound | Exit wound |
|---|---|---|
| Size of the wound | Smaller than exit wound | Relatively bigger |
| Pattern of edge | Inverted | Everted |
| Beveling of edge | Present | Absent |
| Abrasion contusion | Present | Absent |
| Hemorrhage | Less | More |
| Colour changes of track | Present (pinkish colour) | Absence |
| Impacted fiber | Turned in | Turned out |
| Presence of carbon monoxide | Found in high quantity | Very less in comparison to entry wound |
| Impression of muzzle | Present (in contact shot) | Absent |

## Medico-legal Importance of Firearms Injury

- Firearm wounds could be recognized from appearances of clothing and presence of entry and exit wounds.
- The size, shape, composition of bullet, examination of cartridge helps to ascertain the nature and type of fire arm used.
- Matters such as presence and absence of burning, contusions, colour changes etc. help to determine distance and direction of gunshot.
- If more than one gunshot injury is present in the same body, firearm examination helps to determine whether the bullets are fired from same gun or different guns.
- Site of gunshot and other circumstantial evidences help to ascertain whether case is homicidal, suicidal or accidental.
- Reaction between body tissues and chemicals help to indicate time passed after gunshot.
- Post mortem examination of deceased renders information regarding cause of death, manner of death and post injury survival duration/time.

## Differences between Homicidal, Suicidal and Accidental Firearm Injury

Different factors are relevant to determine whether the questioned firearm injury was homicidal suicidal or accidental. The position and direction of the firearm injury, presence of weapon at the scene of crime, number of firearm opened, nature of wounds, violence marks at the scene of crime etc. are of very much importance to determine the nature of firearm injury. In homicidal firearm injury, contact firearm is rarely used and the weapons may not be found in the scene of crime. Suicidal firearm is mostly made through contact with body skin; muzzle of the gun may me imprinted in surrounding entry wound. Single gunshot is usually found in case of accidental and suicidal firearm injury. Basic differences among homicidal, suicidal and accidental firearm injury are as follows:

| Differences | Homicidal | Suicidal | Accidental |
|---|---|---|---|
| Entry point | Any part of body | Right temporal bone/heart usually | Any area |
| Distance of shoot | Any range | Contact/very close | Any range |
| Number of wound | One or more | Usually one | One (except automated) |
| Powder residue in victim's hands | Not present | Present | Present |
| Scene of crime | Firearm usually absent | Found | Found |
| Motive | Take life of other | Give life/pressure/ tension | No motive. Accident |
| Firearm user | Usually male | usually male | Gender not specific |

## 2) Thermal injuries

An injury produced to a body due to exposure with heat or cold is thermal injury. Contact with heat or cold that normal human body cannot resist results into thermal injuries.

### A. Due to heat

An injury caused by heat can be further classified as burn and scald injury.

### i. Burn Injury

Excess heat transmitted to human body causes irreversible death of body cells and tissue thereby causing burn injury. Factors such as degree of applied temperature, ability of human body surface to conduct away the excessive heat, and the time period of exposure in heat are important to examine the injuries produced by heat.[90]

External body cells are elongated by and flattened by burn. Small hemorrhage may be seen in the deepest layers of the skin. When a person is exposed for about 5 to 6 hours in a minimum temperature about 44°C, it causes burn injury. In case the temperature is more than 65°C then burn injury may result after two seconds of contact.[91]

The nature of burn injury depends upon the nature of heat applied such as heated solid body, fire, volcano, petrol burn, radioactive rays. Damage of the body tissues may be only upto epidermal tissues, subcutaneous tissues or even deep body organs. Burning is useful method to destroy human body; it may also to be used to hide real identity of the deceased by damaging face and other identification marks.

Cause of death in case of burning could be due to: (a) Primary shock producing extreme pain, (b) Secondary shock resulting from massive loss of fluid from burned surface, (c) Inhalation of toxic gases along with smoke in burn trap, (d) Accidental concussion that occurred during haphazard escape effort, (e) Skull bone may be fractured and skull may open up resulting death.

## Post mortem appearance in burn

In burn injury, various external features could be noted. Clothes of victim are burn completely or partially. Skin and bones may be constricted due to evaporation of fluid. The burnt areas will be found reddened, or blistered or charred. Smoke particles and colour may be found around the injury and burnt black skin may be seen. Hair may be singed or completely burnt. Face may be swollen and distorted. Smell from the burnt wounds are noticed. Froth may be noticed due to pulmonary odema caused by heat irritation in air passage and lungs.

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[90] Bernard Knight & Pekka Saukko, Knight's Forensic Pathology, 312 (3rd ed. 2004).
[91] Supra note 1 at 271.

Pugilistic character (posture that is similar to a kneeling position but is involuntary) may be seen in case of exposure to extreme heat. Limbs of victim are flexed, tighten and constricted forming like post mortem stiffening. Heat rupture may be seen due to exposure to great heat. The heat rupture produced by splitting of soft tissues might seem like laceration or incised wound. However, there is absence of bleeding in the wounds produced by heat rupture due to coagulation of blood in the vessel. Flash burn is noticed in the case of ignition of highly flammable gases or liquids.

If victim had experienced intense heat on head, autopsy examination shows heat hematoma.

## Medico-legal Importance of Burn Injury

Burn injury examination has following importance in regard to justice administration:

- To decide whether the ante mortem burn injuries were sufficient to cause death.
- If there is any finding in the body that suggest any other causes of death like poisoning, fatal mechanical injuries or violent asphyxia like strangulating or throttling, should be observed.
- Whether burning was accidental, suicidal and homicidal.
- Whether burn injuries are ante mortem or post mortem in nature. After the death, parts of body that are in contact with ground do not show burning.

## Ante mortem burn and post mortem burn

If a living person's body or some body part comes in contact with heat, ante mortem burns are caused. Ante mortem burn may be homicidal, suicidal, accidental or even fabricated. Burning of a dead body or post mortem burn is done either as a ritual of funeral culture or to conceal guilt and destroy evidences existing on corpse. Post mortem burn in the form of funeral is a common mode of disposition of dead body. In suspicious post mortem burn, offender might have used kerosene or other flammable liquid to burn the deceased. The basic differences between ante mortem and post mortem burn are as follows:

| Differences | Ante mortem burn | Post mortem burn |
|---|---|---|
| Tissue colour change | Present | Absent |
| Blister formation | Blister with serous fluid & red base | Contains air & thin clear fluid. Its base is dry, hard and yellow |
| Colour of blood | Cherry red due to Carbon monoxide | No change seen |
| Smoke in lungs | Present | Absent |
| Forth in mouth and respiratory passage | Present | Absent |
| Enzymes | External site of the burn may show increase in enzyme reaction | May not show |

### Identification of Motive of Burn Injury

Identification of motive of burn injury is important to ascertain whether the questioned burn injury is homicidal, suicidal or accidental. Homicidal burn is intended to take life of other though this kind of burn is rare in nature. A weaker person or sleeping may be murdered by pouring petrol or kerosene on the body igniting fire. While the intended victim is sitting or sleeping inside the room, offender might have poured kerosene, burnt fire and might have locked the door from outside.

Usually, suicidal burn is very rare. This is because self-burning involves extreme pain and is not certain for death. Constant domestic violence, battered women syndrome, acute chronic disease, social stigma etc. may be some reason for a woman to burn herself. In suicidal case, extreme burning may be seen. The inflammable liquid may wet whole body of the suicide.

Accidental burn is more common and found in large number of cases. Disaster, gas plant blast, oil station ignition, gas cylinder in house, air crash etc. are common accidental occurrence to cause burning of person. Negligent handling of inflammable substance is repeatedly seen in the form of explosion.

## Classification/Degree of Burn

### (a) Modern Classification

1. **Superficial burn:** Epidermis fully affected, sometimes up to part of dermis. Depth of lesion does not extend beyond part of thickness of the true skin. No permanent scar formation is seen.
2. **Deep burn:** All layers are affected. The lesion involves whole depth of true skin to its minimum. All burn injuries involving the whole thickness of the true skin or deeper tissue are grouped in this type. Permanent scar formation exists.

### (b) Dupuytren's classification:

This classification is based on depth of lesions and includes six types of burn.

(i) First Degree: When low degree heat is applied for very short duration, there occurs an erythema or redness over area of contact. It remains painful for a day or two and redness fades in few hours or a day. The covering superficial layer of epidermis may get devitalized and sheds off in few days.

(ii) Second Degree: The epidermis is affected completely. There occurs blister formation surrounded by a zone of hyperaemia. The blisters contain serous fluid rich in protein and chloride. These are very painful and if extensive; also produce hypovolemic shock. They usually heal in one week, without scar formation, may rupture and get infected.

iii) Third Degree: The epidermis is completely destroyed with involvement of dermis. There occurs blister formation with red line. They ulcerate and may get infected and are extremely painful. They heal with formation of scar.

iv) Fourth Degree: Whole thickness of skin is involved. These are not much painful owing to destruction of nerve ending. Usually followed by sloughing after some days.

v) Fifth degree: Depth of lesion extends further and subcutaneous tissue is involved. These are less painful owing to total destruction of sensory nerve endings. These heal with deep scarring, produce contractures and when close to a joint, seriously hamper the movement at joint.

vi) Sixth Degree: In this, muscles and bone are also involved.

There occurs charring of the limb. It heals with much difficulty with contracture formation.

## (c) Wilson's Classification

1. First degree burn: Here is involvement of epidermis alone. There is erythema or erythema and blister formation. Injuries are painful and heal without scar formation. Death

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may occur if body surface area is extensively involved. Death may occur due to primary shock within a few hours, within about 2 days due to hypovolumic or secondary shock, and due to infection and other systemic causes subsequently. Rupture of blister may cause infection followed by ulcer and healing by scar formation. These include 1st and 2nd degree of Dupuytren's classification.

2. Second degree burn: These are dermo-epidural burn injuries which are painful and heals with permanent scar formation. These include 3rd and 4th degree of Dupuytren's classification.
3. Third degree burn: When the lesion extends beyond the depth of the true skin, it is 3rd degree of Wilson's classification which includes 5th and 6th degree of Dupuytren's classification. These are less painful; they heal with scar and contracture formation, causing disfiguration and loss of function of the part of the body involved particularly when near a joint.

## Wallace's Rule of Nines

The Wallace rule of nines is a tool used in pre-hospital and emergency medicine to estimate the total body surface area (TBSA) affected by a burn. In addition to determining burn severity, the measurement of burn surface area is important for estimating patients' fluid requirements, determining hospital admission criteria, and ascertaining compensation to victim at courts. The rule of nines was devised by Pulaski and Tennison in 1947, and published by Alexander Burns Wallace in 1951.[92]

To estimate the body surface area of a burn, the rule of nines assigns TBSA values to each major body part.[93]

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[92] Wallace, A. B. (1951-03-03). "The Exposure Treatment of Burns". *The Lancet.* Originally published as Volume 1, Issue 6653. 257 (6653): 501–504.

[Degree of Burns : *See figure 15.8 in figure section]*

It is important that the assessment of burn size be performed accurately and adequately as the outcome can impact on the decision whether or not to transfer the patient to a burn center and on the initial volume requirement for fluid resuscitation, among other things. The majority of assessments of percentages of total burn surface area (%TBSA) to-date have revealed inaccuracies, mostly related to human error, with overestimations of more than 100% identified in emergency departments.[94]

Generally, more than 30%TBSA may be dangerous. But, more than 50% involvement of body surface is expected to be fatal. Infants, very young children and old subjects are more likely to succumb to extensive burn injuries. Elderly children and young adults can withstand burn injuries better. Subjects above 40 years of age are likely to succumb with over 40% surface burn injury.[95]

However, so far as fatality of burn injury is concerned, area of involvement of the body surface is more important besides age, degree of heat applied, time of contact with heat, and depth of burn injury.

Three predominantly used and established methods of burn

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[93] Hettiaratchy, S. Papini, R (July 2004). "ABC of burns: Initial management of a major burn: II—assessment and resuscitation". *BMJ.* 329 (7457): 101–103.

[94] Giretzlehner M, Dirnberger J, Owen R, Haller HL, Lumenta DB, Kamolz LP: The determination of total burn surface area: Howmuch difference? Burns, Epub Apr 5, 2013. (Retrieved on 21-10-2020:http://www.medbc.com/annals/ review/vol_27/num_2/text/vol27n2p101.pdf)

[95] Supra note 6 at 212

size estimation are: (a) "Rule of Palm"[96] (b) "Rule of Nines"[97], and (c) "Lund-Browder Chart".[98] In adults, the "Rule of Nines" is used to determine the total percentage of burned regions per body segment. In some cases, burn injuries only partially affect a region or even extend beyond it, and thus such burns are measured using the palm of the injured person as a reference representative of 1% of body surface area ("Rule of Palm"). According to previous reports, the Rule of Palm can lead to overestimations of about 10–20%[99] because, in adults, the surface area of the palm, including the fingers, represents only 0.8 %TBSA in men and 0.7 %TBSA in women. Excluding the fingers, the averages are as low as 0.5 and 0.4 %TBSA in men and women respectively. In children, the palm approximates 0.92 and 0.52 %TBSA with and without the fingers, respectively. According to Wallace, the Rule of Nines is quite accurate in persons weighing about 10–80kg. However, overestimations of %TBSA by use of the Rule of Nines occur,[100] especially in persons with higher body-mass indices.[101] To overcome this, a proportionate adaptation previewed a "Rule of Five" for persons >80 kg, and a "Rule of Eight" for those less than 10 kg of body weight.[102]

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[96] Rossiter ND, Chapman P, Haywood IA: How big is a hand? Burns, 22: 230-1, 1996.

[97] Knaysi GA, Crikelair GF, Cosman B: The rule of nines: Its history and accuracy. Plast Reconstr Surg, 41: 560-3, 1968.

[98] Lund CC, Browder NC: The estimation of area of burns. Surg Gynaecol Obstet, 79: 352-8, 1944.

[99] Amirsheybani HR, Crecelius GM, Timothy NH, Peiffer M, Saggers GC, Manders EK: The natural history of the growth of the hand: I. Hand area as a percentage of body surface area. Plast Reconstr Surg, 107: 726-33, 2001.

[100] Wachtl Tl, Berry CC, Wachtel EE, Frank HA: The inter-rater reliability of estimating the size of burns from various burn area chart drawings. Burns, 26: 155-70, 2000.

[101] Berry MG, Evison D, Roberts AH: The influence of body mass index on burn surface estimated from the area of the hand. Burns, 27: 591-4, 2001.

The Lund-Browder charts [103] ake into account body proportions associated with different ages and are more precise than the Rule of Nines. Even so, overestimations have still been reported: Alm[104] reported an average overestimation of 17.8% in 90% of cases, Nichter [105] reported 12.4% and Berry [106] identified overestimations of 154% in 25 out of 60 cases.

### ii. Scald Injury

Heat could be produced through two sources. They are by dry source such as fire and hot metal or by wet sources such as hot water, liquid, steam or vapor.[107] produced by hot liquid, its steam or vapor is known as scalds. Scalds injury are less severe because the liquid or gas runs off from the body surface.[108] One second contact of body surface with more than 700C could produce full thickness scalds.[109]

Scalds usually result accidentally. Accidental contact with hot water, liquid and steam is frequent in case of children and old age person having weak mental order.

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[102] Livingston EH, Lee S: Percentage of burned body surface area determination in obese and non-obese patients. J Surg Res, 91: 106- 10, 2000

[103] Lund CC, Browder NC: The estimation of area of burns. Surg Gynaecol Obstet, 79: 352-8, 1944. (Retrieved on 21-10-2020: http://www.medbc.com/annals/review/vol_27/num_2/text/vol27n2p101.pdf)

[104] Alm J: A retrospective Study of TBSA-B Calculating; Manual estimated burnchart versus computerized burncharts. Final Programme and abstracts – 10th Congress European Burns Association Bergen, Norway, 2003.

[105] Nichter LS, Bryant CA, Edlich RF: Efficacy of burned surface area estimation calculated from charts – the need for a computerbased model. J Trauma, 25: 477-81, 1985.

[106] Supra Note 35An injury

[107] Cederic Keith Simpson, Simpson's Forensic Medicine, 169 (Jason Payne et.al. eds. 13th ed. 2011).

[108] Supra note 21 at 69.

[109] Supra note 1 at 278Forensic Jurisprudence

Constant contact of dermis with moist heat causes death of dermis and that burnt dermis will be substituted by new dermis. Scalds are more serious too. When an unconscious person is thrown in immense hot water, the person may die due to shock, fluid and electrolyte disturbance, and secondary infection. However, hot liquid could not dispose the dead body. Thus, identification is easier than in the case of burn death.

## Medico Legal Importance of Scalds

- The time of injury occurrence can be determined from scald.
- Blister formation and intense pain may lead to primary shock.
- Secondary shock may occur due to hypovolumia or loss of body fluid through blister rupture. Then the floor inside ruptured blister appears reddish with serosanguinous discharge and ultimately lead to permanent scalds or temporary (heal by 7 to 10 days).
- Scalds are mostly accidental. Homicidal scalds are rare. Suicidal scalds do not occur because of extreme pain and uncertainty of death.
- Blisters may be formed post mortem, both in fresh and decomposed body. This can be distinguished from ante mortem blister because post mortem blister contains very little fluid which is not much rich in protein and chloride. Similarly, blisters may be produced due to irritant plant juice (e.g. calotropics or semicropus plant) and systemic drugs and poison (barbiturate) may be diagnosed and differentiated by their feature including size and distribution.

## Difference Between Burning and Scalds

| Difference | Burning | Scalds |
|---|---|---|
| External appearance | Clothes burnt; singeing hair; fuel smell | Extensive blister/rupture blister exists |
| Cause of death | Asphyxia inhaling gases- CO2 or CO or mechanical asphyxia | Evaporation of hot liquid causes infection of extensive scalds |
| Internal appearance | Presence of carbon in mouth/ mucus membrane of respiratory track; Kidneys may show evidence of toxic or ineffective nephritis; Scalp bone may be fractured; Brain may be edematous and meninges may show sign of inflammation; Urinary bladder may show signs of cystitis and may contain turbid urine which on microscopic examination will show presence of red blood cell casts | In shock: There will be minimum other changes; In asphyxia: signs supportive to asphyxia would be seen; swelling of hot liquid or inhalation of hot vapor (sign of burst). In irritation, oedema: Blister formation present inside the mouth and near the larynx. |
| Appearance of skin | Dry and wrinkled | Sodden and bleached |
| Condition of clothing | Dry and may be burnt | Wet |
| Colour of dead body | Black | Bleached |

## B. Due to cold

The severity of cold injury depends on the temperature, duration of exposure, environmental conditions, amount of protective clothing and the patient's general state of health. Exposure to cold can cause localised injury or generalised cooling of the entire body. Cold injury is also known as hypothermia. Hypothermia is defined as a core body temperature below 35°C. Along with coagulopathy and acidosis, hypothermia belongs to the lethal triad of trauma victims requiring critical care.[110]

Substantial reduction of body temperature leads a person to suffer from injury and even to death. Human body organs are suitable to function in average temperature of 35 to 37°C. When a person is exposed to extreme cold geography, body temperature starts falling down due to reduced metabolic rate in proportion to the fall in core body temperature and various physical anomalies may be seen.[111]

It is important to note that unusually extreme cold weather is not required to develop effect of hypothermia. It results if normal temperature of person slightly falls down.[112]

Children, chronic patient or elderly person may get exposed to hypothermia even in moderately cold winter season. During winter, few deaths through hypothermia are noted in Terai region each year.

## Mechanism of Cold Injury or Death

General mechanism involved in cold injury is as follows:

i. A person when exposed to cold weather or environment, body temperature transfers to surrounding environment and feelings of cold begin.

ii. Physiological processes attempting to prevent further reduction of body temperature begin such as putting more clothes on body or covering the exposed part of the body from external environment.

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[110] Avellanas ML, Ricart A, Botella J, et al; [Management of severe accidental hypothermia]. Med Intensiva. 2012 Apr36(3):200-12. doi: 10.1016/j.medin.2011.12.005. Epub 2012 Feb 9. [Retrieved 15-10-2020: https://patient.info/doctor/hypothermia-pro#ref-1]

[111] Supra not 16 at 307

[112] Supra note 41 at 176

iii. Shivering, prevention on blood flow to skin, releasing hormones to generate heat may be seen.

iv. Prolonged exposure to cold result inadequacy of body response to preserve heat and decrease on heartbeat.

v. Cardiovascular and nervous system gradually start to feel depression and lead death.

## Some Types of Cold Injury

Sufferings and injuries caused by coldness can be classified in accordance to the degree of injuries caused. Medically, these can be classified as mild cases, moderate cases and severe cases in accordance to the suffering caused by the degree of temperature reduction rate causing and showing different symptoms. Mild cases of injury could be caused by reduction of temperature up to 32-350C from the average 37.5 0C. Mild cases refer injury caused in temperature of 30-320C. Reduction of temperature below 300C results into severe injury.[113] For general understanding, major injuries caused by coldness are:

### i. Frostbite

Frostbite occurs by exposure to dry cold such as in mountain climbers. An atmospheric temperature below 00C is required to cause frostbite.[114] The process of frostbite injury begins from appearance of numbness, tingling and damage of tissues. Skin seems waxy, white and grey in colour known as frostnip. Absence of treatment during frostnip and prolonging exposure to cold form ice crystal in skin and deeper tissues resulting edema of tissues.

[Frostnip & Frostbite : See figure 15.9 & 15.10 in figure section]

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[113] Supra note 41 at 176

[114] Supra note 1 at 265

### ii. Trench foot or Immersion foot

Exposure of human into damp/moist cold about 5 to 80C causes trench foot. Exposed body parts such as limbs and shoulders are wet due to immersion. Due to extreme cold, tissues of finger, toes, hands and feet may get dead through anoxia and absence of blood for long time. Constant reduction of temperature leads to frostbite.

[Trench Foot : *See figure 15.11 in figure section]*

In both these sort of injuries, finger, hands, toes and hands are more commonly affected. Cold affected parts may be seen pale due to effect of vasoconstriction which further leads to vaso-paralysis. Clumping (clotting) of the blood, occlusion (blockage) of the blood vessel and local oedema (fluid filled) may be seen. Lack of blood circulation over the affected parts lead loss of control of hands, feet and other body parts. Prolonging extreme cold further results unconsciousness, stoppage of breathing, stiffening of muscles, dilation of pupils and furthermore death of victim.

## Post Mortem Appearance of Death Due to Cold

Death due to hypothermia may show following appearances:

a. Pinkish discoloration over the large joints may be seen.

b. Rigor mortis start late and stays for longer time.

c. Dead body may get stiffened before rigor mortis.

d. Body organs and viscera show congestion.

e. Numerous superficial hemorrhagic gastric erosions on the lining of the stomach may be seen.

f. Petechial Hemorrhage in lungs and intestine may be seen.

g. Presence of oxyhemoglobin in arteries may result bright red colour of blood vessel.

## Medico-Legal Importance in Hypothermia Death

Medico legal examination of dead due to hypothermia is mainly directed to determine whether the person: (i) already died of some reason but later on was thrown into cold area, or (ii) actually died due to cold. The external and internal appearances of dead body show numerous signs that help identify the cause of death.

Likewise, it is important to differentiate homicidal, suicidal, and accidental death due to cold. Accidental exposure to cold is more common in poor, elderly, child, and drunken cases. Suicidal hypothermia is not common in nature. Homicidal death through cold is also rare one. Because cold takes time to take life of person and the assailant may not have, sufficient time to wait until death. Hands and legs of deceased may have been tied in back side in homicidal case in order to prevent movement of victim.

Immersion in extreme cold water may result more speedy death than cold air due to faster freezing rate. If in the name of extracting confession during interrogation, a detainee dies of torture or if the detainee is made to immerse up to neck level in cold water for whole winter night and the person dies, it is to be considered as homicide generating individual liability of those on duty. Likewise, immersing up to neck for whole night to anybody including but not limited to any victim of unlawful detention, kidnapped victim, prisoners of war, and members of opposite force under control during insurgency etc. if results into death are to be considered as a crime of homicide creating individual liability.

## 3) Chemical injuries

Chemical injury may also be categorized as burn injury because contact of body surface, tissues or organs such as skin, hands, face, eye etc. to a strong acid produces chemical burn wounds. It is one manner of burning injury.[115] Acute toxin such as hydrogen cyanide, hydrogen sulfide, nitrogen dioxide, ricin, organophosphate pesticides, arsenic are more dangerous and can cause severe injury or even death.[116]

Poisoning is common method where intake of chemical causes severe injury to internal organs of the human body and resulting to death.

Theoretically, cases and symptoms of poisoning differ from type of chemical toxins applied to cause injury. Some chemicals result systemic poisoning as well as burn effect according to their toxic nature. If toxic effects occur at multiple sites, it is called systemic toxicity. Contact with acid damages skin and subcutaneous tissues. Disfiguration of natural posture of the human body may occur due to burning.

### A) Corrosives

Corrosive is a highly reactive substance that causes obvious damage to living tissue. Corrosives act either directly, by chemically destroying the part (oxidation), or indirectly by causing inflammation. Acids and bases are common corrosive materials. Corrosives such as these are also sometimes referred to as caustics. Typical examples of acidic corrosives are hydrochloric (muriatic) acid and sulfuric acid. Typical examples of basic corrosives are sodium hydroxide and lye.[117]

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[115] A.J Chapman, Death and Deduction - A Reasoned Approach to Forensic Pathology, 238 (1st ed. 2001).

[116] Available at http://www.fss.txstate.edu/ehsrm/safetymanual/chemical/toxchems.html (accessed on 18 April 2018).

Corrosive material can attack and chemically destroy exposed body tissues. Its contact causes immediate damage to skin, eyes, respiratory tract and viscera.

### Types:

Corrosive can be roughly categorized as follows:

1) Corrosive acid: acidic corrosive includes hydrochloric acid, sulfuric acid, nitric acid, chromic acid, acetic acid etc. the burn injury produced by it may be refereed as corrosive acidic injury. Corrosive acid acts in an opposite fashion and precipitate proteins forming burn injury. The characters of acid bun injury are dry, clearly defined and hard. Second-degree class of burn injury may be seen due to mild edema.

2) Corrosive alkali: corrosive material having base is known as corrosive alkali. Common corrosive alkali includes potassium hydroxide, sodium hydroxide etc. Injury caused through effect of it may be referred as corrosive alkali injury. Corrosive alkali injury is deeper than acidic injury because it dissolves proteinaceous tissues and form soap from the fatty tissues.[118]

## Modes of Administration

Corrosives can be found in both substance and gaseous form. Common modes of administration of corrosives in human body are:

1) Contact on body surface: Contact of chemical on body surface is common to person regularly working in business where handling corrosive chemical is habitual. Attack on someone with these chemicals is a criminal offence. It may

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[117] Available at http://www.ilpi.com/msds/ref/corrosive.html(Retrieved: 16-10-2020)

[118] Supra note 52 at 246

cause burn to body skin and damage to subcutaneous tissues and even inner body organ. Some corrosives are toxic in nature and could result irritation, allergic reaction and blister or reddening of tissues. For instance, eye contact of glutaraldehyde chemical may cause severe eye injury.

2) Inhalation: Inhalation of air containing corrosive vapor is another mode of administration. Industrial hazard may cause leakage of gaseous chemical and the workers may accidentally fall as victim of chemical. Inhalation of corrosive vapor produces irritation or even burn to inner lining of the nose, throat, air passage, and lungs etc. Inhalation is more fatal than in case of skin contact.

3) Swallowing: Person may swallow corrosives or liquid chemicals. Children coming into contact of such fatal chemical may swallow accidentally and suffer from severe injury or instant death. An act of swallowing corrosive chemical damages mouth, throat, pancreas, intestine and the effect may reach upto kidney.

## Factors Affecting Corrosive Injury

Damage inflicted by corrosive or other chemical to body tissues depends on following elements:[119]

- Nature, types and amount of corrosive.
- Strength and concentration of corrosive.
- Capacity of skin to resist.
- Duration of contact with corrosive.
- Degree of penetration to inner tissue.

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[119] Supra note 52 at 245

## General Appearance of Corrosive Injury

- Skin or tissues that came into contact of chemical appears black and necrosed.
- Irritation, red lining or burning effects are seen in the area of contact.
- Numbness of affected skin may be seen.
- If chemical is exposed to eye, it might lead to vision depletion or blindness.
- In case of inhalation or swallowing of corrosive, cardiac arrest, unbalanced heart beat, low breathing ratio, coughing or unconsciousness of victim etc. may be recorded.
- Post mortem of the victim may show coagulation of protein, formation of salt, corrosion, inhibition,[120]
- If chemicals are corrosive alkalis, deep burn, liquefactive necrosis, and edema may be seen.

## Electrocution Injury

Electricity is an energy that moves in a path with a tendency to pass to the earth, where it will be neutralized. Electrocution occurs when there is a passage of electricity through the body from an entry point to exit point. For an electric shock to occur there must be contact of a body with both positive and negative pole and alternatively, the earth. Without this passage, there is no ill effect, as in birds perched on overhead cables.

The affected sites of electrocution may be domestic, industrial, commercial centre, transport system, and electricity distribution system. Factors determining outcome of electrocution are as follows:

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[120] Supra note 52 at 245

1) Voltage: Voltage is the measurement of electrical force. It is the current in volts. The supply of more than 50 volts may be dangerous and around or above 100 volts is definitely dangerous. In Nepal and India, the voltage of domestic supply is usually 200-240 volts, alternating current with 50 cycles per second.

2) Ampere: It is the intensity or amount of current flow through the body. The intensity of current flow depends upon voltage and resistance of human body. The current flow is larger when resistance of body is lesser for a constant voltage. The ampere of current is more important than voltage of current to determine the effect of electric shock. This is why a person touching electricity with moist hands is more severely injured than the person with dry hand. This is because dry hand is comparatively more resistant than wet hand. Fifty milliamperes (50 mA) across the heart for a few seconds is very likely to be fatal at 100 volts, though death has been recorded at 50 volts and even 24 volts when the time of flow was long.[121]

3) Resistance: Skin of a person as protective layer offers some degree of resistance to the flow. Dry and thick skin offers more resistance being a bad conductor. The amount of resistance offered to the flow of current follows Ohm's law. Earthen with wet shoes or bare soles increase fatality.

4) Nature of current: Alternating current is 4 to 5 times dangerous than an equal voltage of direct current.

5) Frequency of current: Greater frequency of current is more dangerous than lower frequency current.

6) Duration or time of contact: Duration of passage of electric current is also a factor. In high voltage, short duration of

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[121] Supra note 23 at 328.

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contact is fatal one because person is immediately thrown of violent muscular contraction. Similarly, in low voltage, long duration of contact is required for fatality.

## Signs of electrocution

The electric flow depends on structural morphology of tissue, fluid contents of tissue and chemical composition. It determines presence of various signs. Following signs could be found in electrocution:

1) Lesion at entrance: Current passing through skin produces heat, causes boiling, and electrolysis of tissue fluids. The skin explodes and rolls back from the surface. Moist skin may not show electric burn but thick dry skin shows well marked electrical burn or crater. There are ridges around crater. Creases of skin metallic dust of conductor is seen under microscope. Scorching, blackening, charring, abrasion and laceration, hyperemia lining, coagulation, necrosis and deep burn of fourth or fifth degree may be seen.

2) Lesion at exit: Site of exit depends on which body part is nearest and in contact with the earth. It is commonly bare foot. If foots are insulated with shoes's dry rubber soles but other body part e.g. arm, chest, back etc. is in contact with wall, it will act as earth and then the point of exit will be that earth touching body part and injury or lesion is caused there. Production of fire and flash may cause burning. There will be coagulation and flattening of cells that may be seen through microscope.

3) General features: There may be the feeling of tingling and numbness in affected body part. Mental confusion, lack of response, partial deafness, defective vision or headache may occur. These are temporary and may remain for some hours or days or may occur even after recovery from electric

shock. Paralysis may occur in some cases due to degenerative changes in the nervous system. Optic atrophy and other intra ocular lesions may develop several months afterwards. Delayed myelopathy and bilateral cataracts may be reported.

4) Death: Effects of current flow through base of the brain (this leads to unconsciousness, failure of three vital centers), heart (it leads to ventricular fibrillation or failure of heart contraction) and surface of body (respiratory arrest due to spasm and paralysis of the respiratory muscles) could lead to death.

## Cause of Death

The human body is a good conductor of electricity. This means an electric current can easily travel through it. When current travels through someone's body accidentally, this is known as an electric shock or electrocution. In electrocution, cause of death may be:[122]

1. Ventricular fibrillation: When ventricular fibrillation occurs, the heart stops pumping and the blood stops circulating. The victim rapidly looses consciousness and dies dies if a healthy heartbeat is not restored with a device called a defibrillator. If a current of 50 mA passes through the heart, it can cause cardiac arrest. The heart is also a muscle, which beats to pump blood through the body. The rhythm of our heartbeat is controlled by electric impulses- it is these impulses that are monitored by an electrocardiogram. If a current from outside the body passes through the heart, it can mask these impulses and disturb the heart's rhythm. This irregular heartbeat is called arrhythmia and can even manifest as a total disorganization of the rhythm, known as

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[122] https://www.hydroquebec.com/safety/electric-shock/consequences-electric-shock.html

ventricular fibrillation. The arrhythmia can occur at the time of the shock or in the hours following the electric shock.[123]

2. Paralysis of respiratory centre or respiratory muscles: It may lead to asphyxia. A shock can cause muscle spasms. Muscles are stimulated by electricity. The effect depends on the intensity of the current and the type of muscle it travels through. We've all felt a buzzing or tingling sensation that doesn't cause injury. That's the effect of a current as low as 0.25 milliamperes (mA) entering the body. When a current above 10 mA travels through flexor muscles, such as the ones in our forearms that close the fingers, it causes a sustained contraction. The victim may be unable to let go of the source of the current, making the duration of the contact longer and increasing the severity of the shock. When a current above 10 mA travels through extensor muscles, it causes a violent spasm. If the muscles affected are the hip extensors that lengthen the limbs away from the body, the victim may be propelled, sometimes many metres away. Muscles, ligaments and tendons may tear as a result of the sudden contraction caused by an electric shock. Tissue can also be burned if the shock is lasting or the current is high.

A shock can cause burns to tissues and organs. When a current above 100 mA passes through the body, it leaves marks at the points of contact with the skin. Currents above 10,000 mA (10 A) cause serious burns that may require amputation of the affected limb. Some burns are easy to recognize because they look like the burns you can get from contact with heat. Others may seem harmless but aren't:

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[123] Ibid.

tiny charred craters indicate the presence of much more serious internal burns. Electrical burns often affect internal organs. They are caused by the heat generated from the body's resistance to the current passing through it. Internal damage may be much more serious than the external injuries suggest. Internal burns often have serious consequences: scarring, amputation, loss of function, loss of sensation and even death. For example, if a lot of tissue is destroyed, the large amount of waste generated can cause serious kidney or blood circulation disorders.

3. Secondary causes: Secondary cause such as fall from height or concussion may cause other fatal injuries. A shock can have other unexpected consequences. Other disorders can appear in the weeks or months following the shock, depending on which organs the current passed through. For example, if the current passed through the eyes, cataracts may develop over time.[124]

## Post Mortem Appearance

1) General appearances:

    a) Lesion at entry (joule burns due to heat) and exit (crocodile flash burns if contact with high tension current in false surface area) are common.[125]

    b) Blister may be seen in entry injury.

    c) Microscopic observation or acroreaction test may detect metallic dust particles at the point of entry.[126]

    d) In case of death due to respiratory failure, general appearance of asphyxia may be seen.

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[124] Supra note 35

[125] http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000016FS/P000701/M015732/ET/1464332631FSC_P14_M24_e-text.pdf

[126] http://www.hitachi.com/rev/pdf/2016/r2016_07_110.pdf (Retrieved: 19-10-2020

e) Effects of haematoxylin and eosin show necrosis, flattened cells, blackened tissue.[127]

f) Rigor mortis appears early and post mortem lividity is well developed.

2) Internal appearance:a) General visceral congestion is seen.

b) Ecchymosis may be noticed along the path of current.

c) Changes in the nerve cells and fragmentation of the axons in the peripheral nerves may be reported.

d) Generally heart chambers may be filled with clotted blood.

e) Extensive muscles damage may produce myoglobinuria.[128]

## Medico Legal Importance

The chief medico legal question is to determine whether electrocution is accidental, suicidal, or homicidal. Accidental electrocution may occur due to defective household electronic appliances, use of heater in bathroom, lightning etc. Accidental electrocution is more frequent in bathroom. Accordingly, suicidal electrocution is rare. However, remarkable rate of increase in suicide through electrocution have been reported.[129] In suicidal electrocution upper limbs and opposite lower limb hold the two electrodes. Homicidal electrocution may be done by placing live wire expecting. [130] However, homicidal electrocution is rare.[131] Immediate operation of mature pregnant women is essential because fetus may survive even if mother is electrocuted. Accordingly, a surviving mother may abort after electrical injury. Amniotic fluid which surrounds the fetus in the uterus acts as shock absorber. Some western countries have recognized electrocution as a method to execute judicial decision.

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[127] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6097380/ (Retrieved: 19-10-2020)

[128] https://www.ncbi.nlm.nih.gov/books/NBK557379/ (Retrieved: 19-10-2020)

[129] Supra note 23 at 334

[130] http://www.ilocis.org/documents/chpt40e.htm (Retrieved: 19-10-2020)

[131] Available at http://medind.nic.in/jal/t12/i1/jalt12i1p92.pdf (accessed on 19 April 2018)

## Judicial electrocution

Death penalty is carried out in the electric chair in some states in US. The condemned man is strapped to a wooden chair and one electrode is put on the shaven scalp and the other on the right lower leg. An alternating current (2000 V and 7 amp) is passed for 1 min through the body. The same current is passed through the body a second time for 1 min.[132] In some states of USA, death sentence is executed through electrocution by making prisoner sit on a wooden chair. One electrode is placed on the head and other on lower right leg. A current of about 2000 to 2400 volts is passed twice successively, each time for upto one minute to ensure no chance of failure. In such case, the brain is heated to 60 0C and the vacuolation around the vessel has been noted. William Kemmler was the first person electrocuted to death in New York's Auburn Prison, on 6th August 1890.[133]

## 5) Lightning Injury

Lightning is a flash of brilliant light in the sky produced by natural electrical discharge between clouds to the ground usually followed by thunder. Lightning occurs because of accumulated electrically charged particles on the surface of cloud or snowstorm or dust storm or volcanic eruption or nuclear explosion. However, lightning of cloud origin is common. Lightning is a nature's way of showing electric current, potential, and resistance. The average cloud to ground strike is 3 miles long, and carries 30,000 amps of current.[134]

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[132] Gautam Biswas, Review of Forensic Medicine and Toxicology, (Edn 2, 2012) 246 Jaypee Brothers Medical Publishers (Retrieved 10-19-2020 from: http://bvhmch.in/wp-content/uploads/2018/03/FMT-GOUTAM-BISWAS.pdf)

[133] Supra note 16 at 325

Lightning carries with it a tremendous amount of energy. A bolt of lightning can carry a voltage exceeding 10 million volts with a massive current typically between 30 thousand to 110 thousand amperes. The temperature of a lightning bolt is also extremely hot, reportedly as high as 30 thousand Kelvin. Lighting can be both negatively and positively changed, and can take the form of both direct and alternating current. A victim's exposure typically last from 1/1000 to 1/10 of a second. Not all lightning injuries occur in the same manner with injuries being classified as a direct strike, side splash, contact injury, or ground current. Direct strikes are rare, accounting for 5%, and occur when a person is directly struck by lightning creating an uninterrupted connection between the person and the bolt. Contact injuries occur by touching an object that is struck.[135]

## Types of Lightning stroke from cloud

Three varieties of lightning strokes may occur from the cloud source. They are:

1. Intra cloud lighting: This lightening result due to meeting of positive and negative charges that exist within a same cloud mass. Negative charge exists at lower surface of the cloud whereas positive charge exists on the upper surface of the same cloud. This is not usually visible; only a glow of cloud is seen.

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[134] Justin Hensley, A 7th injury mechanism for lightning? Jan 18, 2019 (Retrieved 19-10-2020: https://litfl.com/a-7th-injury-mechanism-for-lightning/)

[135] Jacob D. Jensen; Jeff Thurman; Andrew L. Vincent. Lightening Injuries, July 19, 2020 (Retrieved on 19-10-2020: https://www.ncbi.nlm.nih.gov/ books/ NBK441920/)

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2. **Inter cloud lightning:** This type of lightning occurs due to flow of negative charge of one cloud to positively charged part of another cloud. It is clearly visible during night where the spark is seen to move from one region of the sky to another.

3. **Cloud to earth lightning:** When the potentiality of the negative charge on the lower surface of the cloud increases and the potential difference between the cloud and the negatively charged earth's surface is great, the negative charge from the cloud crosses the atmospheric barriers (though atmosphere acts as a good insulator) and establishes a channel up to the earth's surface. This flow (speed of flow more than 100 km/sec.) is not usually visible due to low luminosity. It should be noted that the phenomenon of lightning is not a single one way process of downward steam of negative charge. It occurs in steps and the initial step of descent is known as "stepped leader".

For a negative cloud-to-ground discharge (the most common type of lightning striking the ground), the stepped leader (the channel of ionized air) begins in the lower section of a thunderstorm cloud and propagates downward. When the tip of the stepped leader approaches the ground, one or more upward-moving leaders initiate from the ground. The two opposite-moving leaders meet in midair, usually at a point about 300 feet or less above ground. When the stepped leader and leader meet, they provide a conducting path for charge flow, like a wire connecting the cloud and the ground. There is then a tremendous flow of current upwards through this established channel, brightly illuminating it.[136]

Clouds spew negatively charged electricity towards the ground. This is what happens first, and it is not detectable by the human eye. When all these negatively charged particles strike the ground, it meets positively charged objects on the ground. When this happens, positively charged energy goes back up the channel created by the negative particles, and then lightning is created. The part you see is the lightning streak going going upwards, hence the name ground to cloud lightning. This is why in a nutshell, cloud to ground (CG) and ground to cloud (GC) lightning are the same things. It depends on your vantage point.[137]

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[136] Dan Robinson, Lightening FAQ: Does Lightening travel upward or downward? (Retrieved on 19-10-2020: https://stormhighway.com/does_lightning_travel_upward_or_downward.php)

## Mechanism of Lightning

1. Stepped leader: Accumulated negative charge on cloud crosses atmospheric barriers and tries to establish a channel up to earth's surface in order to neutralize.
2. Streamers: When stepped leader comes within 30/40 feet above earth's surface it chooses the easiest and shortest path (the path of least electrical resistance) to the earth. Therefore, a tall tree, a tower, a building, or a standing person may act as route. The negative charge flows through this route and neutralize with positive charge of earth. However, not all charges neutralize with earth and hence they return back towards the stepped leader through the route as ionized channel. This discharge of positive charge and process of neutralization is called as streamers.
3. Return stroke: When the streamer (returning electrons or ascending electrons) collisions with stepped ladder, a tremendous wave of electric current and heat is generated that moves downward at the speed of one hundred thousand per kilometer. This is called return stroke. The

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[137] Jennifer Evans, Ground to Cloud Lightning; The Basics, January 14, 2019. Retrieved on 19-10-2020: https://lightningmaster.com/ground-to-cloud-lightning/)

stroke has strength of several hundreds of millions volts and thousand amperes. The spark has 15 to 20 feet breadth and may affect anything electrically, anything up to 100 feet apart. The spark is neutralized through earthing. The duration of each stroke is 1/1000 second.[138]

Generally, this series of phenomenon i.e. process of return stroke is repeated for 2 to 4 times through the same ionized channel or path. The first lightning stroke branches in its return stroke, nearer to the surface of the earth. However, the repeating strokes do not branch or reach the earth through the main channel.

## Elements of Lightning

Elements causing lightning injury are as follows:[139]

- High voltage electric current
- Heated air or flash and fire generation
- Expansion and regression of altered air surrounding the spark
- Compression of the air constantly throughout the path.

## Effects of Lightning

The immediate effects of lightning are:

1. Burns: Any degree burn injury may present (epidermal burn injury to deep charring). It may appear in zigzag fashion. Sometimes blisters are also seen. These signs may even be seen beneath the cloth.

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[138] Jacob D. Jensen; Jeff Thurman; Andrew L. Vincent. Lightning Injuries, July 19, 2020 (Retrieved: https://www.ncbi.nlm.nih.gov/books/NBK441920/)

[139] P. Jaising Modi, Modi's Medical Jurisprudence and Toxicology 320 (B V Subramanyam, 22nd ed. 1999).

2. **Aborescent marks/filigree marks/lightning marks:** These marks are seen on the skin due to superficial electrocution. These marks are reddish brown in colour and appear like a branching stem of a tree. Marks are caused due to the congestion and rupture of blood vessel (especially veins) and passage of electric current through them.

3. **Physical damage:** It may resemble with severe criminal violence like fracture of bones, tearing and burning of clothes and skin. The exit point may be voet (*paitala*) or any other parts of body touching ground, may show tear of skin and rupture mark.

4. **Melting of nylon clothes:** It may melt through effect of massive heat produced in body.

5. **Magnetization of metals:** Metals that are in touch with victim such as bracelets, rings, keys, in pocket, watches, metallic buttons of the cloth, metal buckle of belt are magnetized or show magnetic inducement due to the passage of very high electric current.

6. **Metallic burn:** Metallic wearings like metallic wristwatch band, metallic rings may cause deep burn injuries at their sites.

Lightning injuries are caused by lightning strikes. Lightning delivers a massive electrical pulse over a fraction of a millisecond. It can kill a person by instantaneously short-circuiting the heart. A research report of a 45 year old Bangladeshi lady who was struck by lightning showed the patient underwent immediate loss of consciousness and some superficial skin burn about 1 hour following the event. Over the next few days she was found to have intracerebral haemorrhage and infarct, tympanic membrane rupture and bilateral cataract.

Surprisingly patient did not suffer from any cardiac or renal injury.[140] All lightning strike victims should receive emergency medical support on site of injury and be treated in intensive care units (ICU) equipped with multiple organ support facility.

## Cause of Death in Lightning

Death may result either due to the effect of: (i) current or (ii) generated heat or (iii) mechanical injuries or (iv) two or more of these effects at once. If death is due to current, cerebral anemia occurs due to spasmodic contraction of cerebral vessels. It causes sudden stoppage of respiration and heart muscles contraction. In short, electro thermal injury causes paralysis of cardiac and respiratory centers. If death is due to heat, person falls unconscious immediately due to syncope or concussion and dies at once due to paralysis of nervous system and heart. In short, forceful throw of body on ground or against the wall due to the expansion and compression of air results death.

## Post mortem appearance

Post mortem appearances in case of death due to lightening are as follows:[141]

1) External examination:
    - Mechanical and burn injuries.
    - Arborescent marks on the skin.
    - In some rare cases, no external signs of the effects of electrocution or fire or any mechanical injury may be noticed on the body.

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[140] Rajib Hasan et.al, Lightening Injury, Bangladesh Crit Care J September 2017; 5 (2): 132-134 (Retrieved: https://www.banglajol.info/index.php/BCCJ/article/view/34395/23191)

[141] Id. at 322

- Rigor mortis appears soon after death and passes off quickly.
- Burn at the site of metallic wearing may frequently be noticed.

2) Internal examination:

Internal symptoms are not pathognomomic. However, following features are seen:

- Extensive hemorrhage in the brains, pancreas and occasionally laceration.
- Petechial hemorrhages in lungs and pericardium.
- Blood vessel may be found torn or ruptured and internal organs torn.
- Congestion of the lungs, spleen, suprarenals and kidney.
- Fracture of bones.
- Hemorrhage in middle ear and rupture of eardrum has also been reported.

## Medico Legal Importance of Lightning

It has to be decided whether death was due to homicide i.e. severe criminal violence or lightning. It is important because there may be doubt or confusion because burn, wounds, fracture of bones, tearing of clothes and mechanical injuries alone may be difficult to guess whether it was produced by lightning or criminal violence. Thus, conclusion should be derived only after carefully considering the following points:

- History of thunderstone in the locality.
- Evidence of effects of lightning in the vicinity such as damage to tree, house, death of cattle etc.,

- Fusion or magnetization of metallic substances.
- Absence of homicidal wounds and injuries in dead body.

The vulnerable sites of accidental lightening strokes are:

- Open field.
- Unearthed building.
- Under a solitary tree.
- An airplane passing across the cloud generally do not show any harm from lightning stroke because the electric current passes through the outer surface of the plane. However, very occasionally, the heat generated may ignite the fuel tank and the plane may crash.
- Swimming in pool (swimmer may be electrocuted by the charged water of pool if pool suffers lightning stroke).
- Ungrounded window grill.
- Touching a metallic fencing, telephone wire, antenna, or any inflammable fuel during lightning may result injury.

6) Radiation Injury (Due to x-rays, and radioactive substances etc.)

Iatrogenic effects of diagnosis and therapeutic uses of X-ray and different radiations are matters of constant concern for the clinicians and patients. Cautious and vigilant application of these agents add to the benefit of their uses. A careless attitude is definitely harmful and dangerous.

## General harmful effects of radiation

The harmful effects of radiation[142]could be seen either as

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[142] Supra note 6 at 285.

(a) Acute (immediate) manifestations or as (b) chronic manifestations. Acute (immediate) manifestations include: (i) Nausea, vomiting, general indisposition occur in the initial phase; (ii) a symptom free period follows; (iii) Systematic involvement with excoriation of skin, erythema, blistering, followed by dermatitis and in few of these cases prolonged ulceration of the skin; Gastro intestinal tract disturbances, haemorrhagic condition; (iv) secondary infections.

Chronic manifestations include delayed effects of radiation that could occur after a long period (even few years) of therapy or exposure. Malignant changes may occur in different organs, apart from other problems. The delayed complications or chronic manifestations of radiation are: (i) Malignant changes in different organs and systems, namely, haemopoetic system, lung, liver. Haemopoetic system includes tissues which produce blood cells such as- bone marrow, spleen, and lymph nodes. (ii) exposure during pregnancy may lead to congenital (birth) abnormalities in the child. (iii) conditions like sterility, cataract may develop.

## Dangers of exposure to X–ray

The harmful effects may be on the patient, subjects exposed to X–rays, on the radiologists and radiographers. It could be either as early reactions in patients or as late reactions in patients. Early reactions include- X–ray burn in the form of erythema with surface capillary dilation and pigmentation. Late reactions in patients include- bluish discolouration of the subcutaneous tissue with necrosis and slough formation. Slough is necrotic tissue that needs to be removed from the wound for healing to take place. In case of radiologists and radiographers, continued prolonged exposure may cause epithelioma i.e. abnormal growth or tumour of epithelium that covers the surfaces of organs and other structures of the body.

## Laser Beam Injury

LASER (Light Amplification by Stimulated Emission of Radiation) beam may cause damage to tissue in subjects who work in the laboratories or institution where laser is in use. Commonest of the danger is damage to the retinal vessels.

## Effects of Radiation

Numerous factors influence on the effects of radiation on human body. These are: (a) Age- Young subjects are more vulnerable to the exposure of radiation. (b) Dose of radiation- with 500 rads, chance of death is 50%; with 1000 rads, the danger is 100%. (c) sensitivity of organs to radiations- certain tissues or organs are highly sensitive to radiation, namely bone marrow or germinal cells. On the other hand some of the body tissues are quite resistant to the effects of radiation, namely the connective tissue. (d) Mode of administration- A dose received in a short period is more dangerous than the same dose taken after a gap of long time. (e) Period of effectivity- this depends on half life of different radiations, their elimination etc.

The half life of a radioactive substance is the period required for reduction of the radioactivity of its original strength. Half life may be expressed as: (i) Radioactive half life- time required for reduction of radio-activity by 50%, by way of decay of radio-activity. (ii) Biological half life- Time required by the body for natural elimination of 50% of the substance. (iii) Effective half life- Time required for the reduction of the radioactivity of the substance to 50% of original, by the combined process of decay and elimination.

## Precautions

a. Dose should be carefully decided.

b. To avoid accidental ingestion, inhalation etc. of the used radio-active substance.

c. Those who are exposed to radio-active substances, should be subjected to regular check up investigation, so as to be sure that there has not been any over-exposure or there is no sign of any damaging effect.

### Medico-legal aspects

Usually victims of radiation injuries do not come to a medico–legal expert. However, legal problems may arise in following circumstances: (i) where question of medical negligence against treating doctor for over exposure and causing damage to a patient. (ii) Compensation cases, where workers vulnerable to radiation exposure, do suffer the harm due to the fault of establishment.

## 3. Types of Injuries Recognized by Nepalese Law

*Muluki* Criminal Code, 2074 B.S. is a specific law dealing with wounds and injuries in Nepal. The provision of crimes relating to Assault or Grievous Hurt (Section 191 to 199) prohibit, criminalize, and punish six categories of crimes: (a) assault (*kutpit*), (b) grievous hurt (*aanga bhanga*), (c) hurt by recklessness, negligence and provocation (d) disfiguring by acid/chemical/bio-toxic attack, (e) criminal use of force, and (f) making anybody unconscious with criminal intent.

The law recognizes following three types of wounds and injuries:

(i) Assault (*kutpit*): It is considered offence of assault if anybody: (a) inflicts any form of bodily pain to other, (b) infects disease to other (except Sections 104[143] and 105[144] or negligently (*helchekraayain purbak*- up to 3 years imprisonment and up to Rs 30,000/- fine).), and (c) disables (bodily/mentally) anybody by any means. Anyone who does or causes to do these three acts are liable for up to 3 years imprisonment or up to Rs 30,000/- fine or with both.

(ii) Grievous Hurt (*angabhanga*): Intentional assault upon anybody if results into following 8 injuries, amount to the offence of grievous hurt: a) Damaging eye sight, b) damaging smelling capacity of nose, c) damaging hearing capacity of ear, d) damaging speaking capacity of tongue, e) cutting breast of woman, f) making woman sterile and male impotent, g) breaking backbone or bodily joints such as of hands and legs, h) make someone unable to carry professional activity by assault.

It is not necessary that these 8 consequences are to be seen immediately. Rather, liability is imposed even if these consequences occur later provided that causation needs to be established between assault and any of these 8 injuries. The offender is liable for up to 10 years imprisonment and up to Rs 1 Lakh fine. In case if 2 organs exist in human body having same function and damage is made only to one among such 2 organs, the punishment would be half. Likewise, if recovery of the organ occurred despite grievous hurt, punishment would be of upto 3 years imprisonment and fined with up to Rs 30,000/-.

(iii) Disfiguring anybody with acid/chemical/bio-toxic attack:

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[143] Spreading epidemic intentionally or knowingly (up to 10 years imprisonment and up to Rs 1 Lakh fine), recklessly (*laparbahi purbak*-up to 5 years imprisonment and up to Rs 50,000/- fine)

[144] Intentionally or knowingly: (i) giving blood infected with HIV or hepatitis; (b) sexually engage without precaution; (c) send blood/semen/saliva/spit/any organ of oneself or of infected person into the body of other.

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Prior to issuance of- Acid and other Lethal Chemicals (Regulation) Ordinance, 2077 B.S. on 2077/06/12 that amended sections 192 and 193 of *Muluki* Criminal Code, 2074 B.S. One who inflicted or caused to inflict: (a) bodily pain or (b) disfigures face or (c) disfigures other body part of somebody with acid/chemical/bio-toxic attack, was liable liable with range of punishment. Previously, crime of (b) was punishable with 5 to 8 years imprisonment and 1 Lakh to 5 Lakhs fine. Crime of (a) and (c) was punishable with 3 to 5 years imprisonment and fine of Rs 50,000 to 3 Lakhs. Victim was entitled to receive 100% amount fined to offender as compensation.

Currently, Acid and other Lethal Chemicals (Regulation) Ordinance, 2077 B.S. amended these provisions. Introducing the the ordinance, the government has amended the Section 192 and 193 of the Criminal (Code) Act 2017. The new provision in the ordinance has introduced 20 years imprisonment and Rs. 10 Lakhs (1 million) compensation if the attackers hurled and poured acid on the victims or force them to drink it causing body disfiguration. But in-case of the death of the victim during the treatment or after the treatment, such person would be prosecuted under murder charge sheet. The ordinance has also inserted a provision of taking compulsory approval by the concerned shops and institutions for selling, distributing and producing acid and acid-related other harmful chemicals. If anybody is found selling and distributing acid without license or approval of the government, such company or people would be jailed for three months to one year term and fined from Rs. 50,000 to Rs. 100,000.[145]

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[145] https://risingnepaldaily.com/main-news/govt-endorses-ordinance-on-acid-attack (Retrieved 17-10-2020)

## 4. Medico Legal examination of Wounds and Injuries

*Muluki* Criminal Procedure Code, 2074 B.S. in Section 22 mandates government doctor or health worker to carry medico-legal examination of wounds and injuries. Schedule 16 of the Code provides uniform format for Injury Examination Report. This format is used even in case of examination of detainee.

## 5. Medico Legal Importance of Injuries

a) Degree of punishment depends on grievousness of hurt or injury inflicted.

b) Whether attack or injury was homicidal, suicidal or accidental is determined by the nature of wound.

c) Whether the accused had intention to kill or not is determined by the nature or grievousness and site of wound or injury inflicted.

d) It is also necessary to see who inflicted the injury such as wounds and injuries caused and killed in course of defense of person, property, chastity, in execution of government duty, protection of cow etc. are justifiable.

e) Injury caused by child below 10 years and insane is seen from different perspective than injury caused by other adult person.

f) Pattern of injuries help determine not just the offence committed (suicide, homicide, reckless or provocation) but even determine the extent of liability.

g) Presence of wounds and injury is a prima facie and objective evidence prior to filing case in court for judicial proceedings.

h) Medico legal examination of wounds and injuries is significant both in alive victim and dead person. Death might have caused due to one major blow (principal offender) or secondary blows (secondary offenders) collectively.[146] In group attack, forensic expert may assist court to identify principal and secondary offender, if there is clear identification of blow of each defendant.

## 6. Injury Identification, Documentation & Reporting

Identification of injury is very much important for determining size of injury, manner of inflicting injury, site of injury, severity of injury and other relevant aspects. Medically, identification of the type and severity of injury is helpful for deciding proper treatment and cure. In case of death of a person with numerous injuries on body, proper identification of each of the injuries and identification of particular injury that caused death is important. Injury has direct relation with gravity of offence and amount of compensation.

Section 22 of *Muluki* Criminal Procedure Code, 2074 B.S. mandates medico-legal examination of wounds and injuries to be done through government doctor or health worker. Schedule 16 of the Code provides format of Injury Examination Report. This format is used even in case of examination of detainee. Accordingly, following information should be identified and documented in injury report:

Case registration number; name of the office referred for injury examination along with letter ref. no and date; name, age, date of birth and sex of the injured person; address; name of the accompanying police personnel; name of the hospital/health center; date, time and place of examination; identification mark of the examinee; consent for examination taken from (injured person/family member or others); brief history about the incident (how and when the injuries were produced?; medical history of the examinee; general physique and vitals (height, weight, pulse, blood pressure, temperature, respiratory rate, degree of consciousness); injuries (name, size, site, color, surrounding area, signs of treatment, bleeding, marks, signs of healings, any imprints and content etc.); type of injury (simple, *angabhanga*/grievous, severe, other remarks); type of weapon/object used (blunt force, sharp force, pointed objects, projectile, heat, chemical, others to be specified); condition of patient at time of examination, severity, investigation and reports, treatment provided, referral, follow up, re-examination, opinion (condition of examinee, severity of the injury, age of the injury and possible causative objects are to be considered while framing opinion).

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[146] *Sikilal Yadhav v. Government of Nepal, 2074,* D.N. 9761

Name of the Examiner along with signature, qualification, professional registration no., office/hospital/health center, date should be mentioned along with seal of the hospital/health center. Statutory guidelines require- (i) Injury examination to be conducted by a forensic expert, to the extent possible, and by a trained doctor if such expert is not available. (ii) Report should be prepared by the injury examining expert or doctor. (iii) Report is to be computer typed to the extent possible, if not so, be prepared in understanding manner.

## 7. Homicidal, Suicidal and Self-Inflicted Wounds: Differences

It is very hard to differentiate homicidal and suicidal wounds because often they have resembling features. Homicidal wounds always indicate presence of assailant or third person to inflict injury over the body of victim with motive of taking life of victim. Faulty act of other accompanied by faulty mind is important in law to determine criminal liability of homicidal wounds. An important feature of homicidal injury is presence of defense wound over the body of victim. However, this will not be present in all cases. Presence of defense wounds may depend on ability of victim to react, victim's awareness or consciousness, and circumstances of offence. Marks of violence at the scene of crime often characterize homicidal nature of wounds and injury.

Suicidal wound are also categorized as self inflicted wound. It has one notable exception i.e. suicide pact, were two or more than two persons collectively fall into conspiracy to give their lives and inflict severe bodily injury to one another voluntarily. In suicide pact, the death of all members may not occur at same time and one may survive. This case is mostly seen in love failure.[147] The motive of inflicting suicidal wound is to end life for getting rid of from all materialistic tension and sufferings. Person chooses to cease his existence rather than surviving. Mental torture, depression, feeling of helplessness etc. are major causes of suicide. Some forms of mechanical and asphyxial injuries are common methods of suicidal injury.

Self-inflicted wounds have peculiar motive than that of suicide. Person inflicts wounds and injury over his or her body with self-induced motive such as subsisting false claim, charge other falsely in offence of hurt with motive to cause harshness to opposite party or to divert any criminal suspicion from oneself. Protection of oneself from possible future legal difficulties and causing physical or pecuniary loss to other are primary objectives behind such creation of falsehood and injury. Generally, self-inflicted wounds are not dangerous in nature. However, lack of concentration during the act to produce forged wound may be fatal and one may lose one's life. The self-inflicted wound is also known as fabricated wound. It has some features such as small in size, superficial in nature, multiple in number, usually made at the body part having good access of hand like limbs, face, chest, legs, not is sensitive organs such as eyelids, heart, neck, abdomen and so on.

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[147] *HMG v. Abdul Phate Musalman, 2044*, D.N. 3178q

Major differences among homicidal, suicidal, and self inflicted wounds are as follows:

| Differences | Homicidal wounds | Suicidal wounds | Self-inflicted wounds |
|---|---|---|---|
| Motive of infliction | Take other's life | End own life in less pain and instant death | False claim. Self protection against future legal difficulties |
| Involvement of assailant | One or more assailant | No assailant, only victim. | Mostly one. Sometimes more in conspiracy. |
| Nature of wound | Fatal | Fatal | Not fatal. Superficial. Chemical may produce false contusions |
| Types of wound | Usually incised. Sometimes stab | Usually stab. sometimes incised | Usually incised & small depth |
| Injury site | Anywhere on the body such as bullet hitting | Usually front. Mostly in vital body organs- heart, | Easily accessible part- face, limbs, chest |

| | | | |
|---|---|---|---|
| | from backside | neck, temple[a] etc | |
| Crime scene | Struggle marks frequently seen | No marks of violence | No marks of violence |
| Dying declaration | Not present | Present | Never present |
| Weapons in crime scene | Rarely present | Present | Not present |
| Hesitation Marks | Usually not present | Present | May present |
| Number of wound | Multiple. Equally fatal | Few. Diverse in fatality | Multiple but not fatal |
| Condition of clothes | May show tear | No tear | May self-tear rigorously |
| Defense wounds | Usually present if victim was conscious | Not present | Not present |
| Foreign evidence-hair/saliva/blood | May be present | Not present | Not present |
| Site of wound | Anywhere | Mostly in right side, if suicider is left handed | Mostly in right side, if person is left handed |

[a] The temple is a juncture where four skull bones fuse together: the frontal, parietal, temporal, and sphenoid.

Right-handed individuals are more likely to shoot themselves on the right side of the head, but a contact shot of the right temple does not necessarily imply that the victim was right handed. Right-handed individuals were observed many times when they had shot themselves in the left temple and vice versa.[148] Correlations of the site with handedness show that most individuals held true to form but that a significant proportion (about 5% - 8%) inflicted their wounds on the other side.[149]

[Human Skull : *See figure 15.12 in figure section]*

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[148] Spitz WU. Spitz and Fisher's Medicolegal Investigation of Death: Guidelines for the Application of Pathology to Crime Investigation. 4th ed. Springfield, IL: Charles C Thomas; 2006. (Retrieved 20-10-2020: https://www.researchgate.net/publication/51797977_Suicidal_Single_Gunshot_Injury_to_the_Head_Differences_in_Site_of_Entrance_Wound_and_Direction_of_the_Bullet_Path_Between_Right-_and_Left-Handed-An_Autopsy_Study)

[149] Stone CI. Characteristics of firearms and gunshot wounds as marker of suicide. Am J Forensic Med Pathol. 1992;13:275Y280; Also see: Eisele JW, Reay DT, Cook A. Sites of the suicidal gunshot wounds. J Forensic Sci. 1981;26:480Y485. (Retrieved 20-10-2020: Nikolić, Slobodan & Zivković, Vladimir & Babic, Dragan & Juković, Fehim. (2011). Suicidal Single Gunshot Injury to the Head Differences in Site of Entrance Wound and Direction of the Bullet Path Between Right- and Left-Handed-An Autopsy Study. The American journal of forensic medicine and pathology. 33. 43-6. 10.1097/PAF.0b013e31823a8a32.)